```
/PAL III
/PART II
/PAGE 11
/ROUTINE TO PACK SIX CHARACTERS IN SYM1, SYM2, SYM3
/LENGTH: 25 REGISTERS
*400

GETS,   ISZ TEM1                /SHOULD CHARACTER BE ROTATED?
        JMP ROTE                /YES
        TAD M2          /RESET
        DCA TEM1                /ROTATION COUNTER
PUT,    TAD PNTR                /WHICH WORD IS THIS?
        TAD TEM2                /ADDRESS IS FORMED FROM CNTR2 AND A
        DCA TEM3                /POINTER, TO GET RELEVANT SYMBOL WORD
        TAD CHAR                /GET CHARACTER
        TAD I TEM3      /ADD IN PREVIOUS CHARACTER
        DCA I TEM3      /STORE IT
        JMP I NXCHP     /GO GET NEXT CHARACTER
ROTE,   ISZ TEM2                /THE FOURTH?
        JMP .+5                 /NO: ROTATE IT
        DCA TEM1                /YES: ARRANGE COUNTERS
        CMA             /SO THAT ALL OTHERS ARE
        DCA TEM2                /IGNORED
        JMP I NXCHP     /KEEP ACCEPTING CHARS.
        TAD CHAR
        CLL RTL                 /SIX BITS LEFT
        RTL
        RTL
        DCA CHAR                /PUT IT BACK IN CHAR
        JMP PUT                 /GOT STORE CHARACTER
PNTR,   SYM3+1          /WORD POINTER
NXCHP,  NXCH            /NEXT CHARACTER ROUTINE
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/PAGE 12
/PAL SPACE HANDLER
/WHEN CALLED, THE SYMBOL TYPE IS IN TYPE
/AND THE SIGN ASSOCIATED WITH THE SYMBOL IS IN SIGN
/VALUE OF SYMBOL IS IN SYMVAL.
/MEMORY REFERENCE INSTRUCTIONS ARE IORED INTO BINW
/IF CALLED WITH A + OR -, THE ADDRESS IS ADDED OR SUBTRACTED FROM ADDR
/LENGTH: 28 REGISTERS


SPAC,   TAD INFO                /ANYTHING TO PROCESS?
        SNA CLA
        POPJ            /NO: EXIT
        TAD TYPE                /YES: GET SYMBOL TYPE
        SNA CLA                 /IS IT ZERO?
        JMP INST                /YES, INSTRUCTION
CMBN,   TAD SIGN                /GET SIGN
        SNA             /IS IT ZERO?
        JMP IORC                /COMBINE SYMVAL AND ADDR WITH AN IOR
        SPA CLA                 /WAS SIGN +?
        JMP SUBC                /NO, SUBTRACT
ADDC,   TAD SYMVAL      /ADD ROUTINE - ADD SYMVAL
        TAD ADDR                /AND ADDR
        DCA ADDR                /AND PUT RESULTS BACK IN ADDR
        POPJ            /RECURSIVE EXIT
SUBC,   TAD SYMVAL      /SUBTRACT ROUTINE - NEGATE
        CMA IAC                 /SYMVAL
        JMP ADDC+1      /JUMP INTO ADD ROUTINE
IORC,   TAD ADDR                /IOR ADDR AND SYMVAL
        JMS I IORIN     /GO TO IOR SUBROUTINE
        DCA ADDR                /LEAVE RESULTS IN ADDR
        POPJ            /RECURSIVE EXIT
INST,   CLA CMA                 /SET INSTRUCTION FLAG
        DCA INSF
        TAD BINW                /IOR BINW AND SYMVAL
        JMS I IORIN
        DCA BINW                /LEAVE RESULTS IN BINW
        POPJ            /EXIT
```

```
/PAGE 13
/ROUTINE TO HANDLE CARIAGE RETURNS
/LENGTH:  40 REGISTERS

CARR,   PUSHJ           /RECURSIVE CALL TO SPACE HANDLER
        SPAC            /ADDRESS OF SPACE HANDLER FOR PUSHJ
        TAD ADDR                /GET 12 BIT ADDRESS
        ISZ INSF                /WAS THERE AN INSTRUCTION?
        JMP DPST                /NO
        AND PAGE                /LOOK AT PAGE BITS
        SZA             /PAGE ZERO REFERENCE?
        JMP TPAGE       /NO, CHECK ILLEGAL PAGE REFERENCE
        ISZ ZFLG                /PUT UP PAGE ZERO FLAG
IGO2,   TAD ADDR                /GET ADDRESS
        AND SL7                 /SAVE SEVEN BITS
        DCA ADDR                /SAVE IT
        TAD ZFLG                /IS THIS A PAGE ZERO REFERENCE?
        SNA CLA
        TAD C200                /NO, PICK UP A 1 IN BIT 4
        TAD ADDR                /GET REST OF ADDRESS
        TAD BINW                /GET INSTRUCTION PART
DPST,   DCA BINW                /THIS IS THE ASSEMBLED WORD
        POPJ            /RECURSIVE EXIT
TPAGE,  DCA TEM1                /TEST EQUALITY OF PAGE BITS
        TAD PF          /BUT ONLY ON PASS2 OR PASS3
        SNA CLA                 /SINCE REFERENCE MAY STILL BE
        JMP IGO2                /UNDEFINED ON PASS1
        TAD AACT                /LOOK AT PAGE BITS OF AACT
        AND PAGE
        CMA IAC                 /NEGATE IT
        TAD TEM1                /COMPARE IT WITH CURRENT REFERENCE
        SNA CLA                 /ARE THEY EQUAL?
        JMP IGO2                /YES, RETURN TO PROCESSOR
        TAD PF          /NO, CHANGE PF TO PASS1
        PUSH            /TO FAKE OUT THE ERROR ROUTINE
        DCA PF          /SAVE PF ON PUSHDOWN, SET TO 0
        TAD ADDR                /PUT ADDR ON STACK, ALSO
        PUSH
        TAD C5          /CODE FOR IR IS 5
        PUSHJ           /GO TO ERROR ROUTINE
        ERROR2
        POP             /RESTORE PF
        DCA PF
        JMP IGO2                /RETURN TO PROCESSOR

/SET PAGE 0 FLAG
ZPAGE,  ISZ ZFLG                /HANDLE "Z" AS A
        POPJ            /RETURN
```

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/PAGE 14
/POP ROUTINE TO RECOVER ITEMS FROM THE
/PUSHDOWN LIST
/CHECKS FOR PUSHDOWN UNDERFLOW
/LENGTH: 18 REGISTERS

POPM,   0
        TAD PSHPN1      /CHECK FOR PUSHDOWN UNDERFLOW
        CMA IAC
        TAD P1BGN       /PSHPN1 SHOULD BE GREATER THAN
        SPA CLA                 /P1BGN
        JMP POPM2       /POINTER IS OK
        TAD PSHPN1      /UNDERFLOW
        PUSH            /PUT POINTER ON LIST
        TAD SL3                 /PDL CODE IS 7
        PUSHJ           /CALL ERROR ROUTINE
        ERROR2
        HLT
        JMP .-1                         /DEAD END
POPM2,  CMA             /RESET POINTER
        TAD PSHPN1      /SET IT BACK 1
        DCA PSHPN1
        TAD I PSHPN1    /GET ITEM FROM LIST
        JMP I POPM      /EXIT WITH ITEM IN AC

/ROUTINE TO FIX ENTIRE SYMBOL TABLE
/LENGTH: 7 REGISTERS

FIXT,   DCA INFO                /NO PUNCHING IN MAIN
        TAD PF          /ONLY ON PASS 1
        SZA CLA
        POPJ            /NOT PASS1: EXIT
        TAD SPNT                /ADJUST POINTER
        DCA IAM1
        POPJ            /EXIT


/ROUTINE TO HANDLE "."
/LENGTH: 6 REGISTERS
POINT,  PUSHJ   /REVISION TO TREAT . AS A TERMINATOR
        SPAC    /  EXAMPLE  -  JMP. = JMP .
        TAD AACT                /VALUE OF . IS AACT
        DCA SYMVAL
        ISZ INFO                /REPRESENTS VALID INFO
        CLA IAC                 /TREAT AS SYMBOL
        DCA TYPE
        JMP I SPACI

L04,
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```
/PAGE 15
/DOLLAR ROUTINE
/LENGTH: 65 REGISTERS
*600
DOLLAR, TAD PF          /WHICH PASS IS THIS?
        SZA SMA CLA     /PASS 1 OR PASS3?
        JMP EPASS2      /NOPE, IT'S PASS2
        CLA OSR
        RAR
        SNL CLA                 /LOOK AT BIT 11
        JMP .+3                 /IT IS 0; FORGET IT
        TAD BBB                 /IT IS 1; SET TO PUNCH
        DCA DDD
        TAD CRLF                /CR,LF
        JMS I EEE
        JMS I LDTI      /OUTPUT LEADER-TRAILER
        TAD C377                /OUTPUT A RUBOUT FOR DDT
        JMS I DDD
        DCA LOW                 /INITIALIZE SORT ROUTINE
        DCA LOW+1
        DCA LOW+2
ELOOP,  TAD CRLF                /CARRIAGE RETURN, LINE FEED
        JMS I EEE
        JMP SORT                /GET A SYMBOL FROM SORT
ELOP2,  TAD I TEM3      /GET FIRST WORD OF SYMBOL
        SPA             /WAS IT DEFINED?
        JMP UASYM       /NO, BIT0 IS 1, ERROR
        JMS I EEE       /YES, OUTPUT FIRST WORD
        ISZ TEM3                /INCREMENT POINTER TO NEXT WORD
        TAD I TEM3      /PICK IT UP
        JMS I EEE       /TYPE IT OUT
        ISZ TEM3                /POINTER TO THIRD WORD
        TAD I TEM3      /PICK IT UP
        JMS I EEE       /TYPE IT
        JMS I EEE       /TYPE TWO SPACES
        ISZ TEM3                /INCREMENT POINTER TO VALUE
        TAD I TEM3      /GET VALUE OF SYMBOL
        JMS I OCTI      /GO TO OCTAL OUTPUT ROUTINE
        JMP ELOOP       /RETURN FOR MORE SYMBOLS
OUT1,   TAD C204                /OUTPUT AN EOT FOR DDT
        JMS I DDD
        TAD CRLF                /TYPE A CRLF FOR DDT
        JMS I EEE
        TAD C377                /TYPE A RUBOUT FOR DDT
        JMS I DDD
        JMS I LDTI      /MORE LEADER-TRAILER
        JMP I NEXI      /GO TO NEXT PASS
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/PAGE 16
EPASS2, CLL                 /CLEAR LINK FOR BIN PUNCH
        TAD CKSM                    /PUNCH CHECKSUM
        JMS I PUNI
        JMS I LDTI          /PUNCH LEADER-TRAILER
        JMP I NEXI          /GO TO NEXT PASS
UASYM,  CLA
        TAD TEM3                    /GET ADDRESS OF SYMBOL
        PUSH                /ON PUSHDOWN LIST
        TAD TEM3                    /GET CURRENT LOCATION
        TAD C3              /COUNTER WHEN THE SYMBOL
        DCA TEM3                    /WAS LAST SEEN
        TAD I TEM3          /PUT INTO AACT
        DCA AACT
        IAC
        PUSHJ               /GO TO ERROR ROUTINE
        ERROR1              /CODE FOR UA IS 1
        ISZ TEM2
        TAD I TEM2          /RESET VALUE TO HIGHEST
        AND PAGE                    /ADDRESS ON PAGE
        TAD SL7                     /SET LOW 7 BITS TO 1
        DCA I TEM2
        JMP ELOOP           /RETURN FOR MORE SYMBOLS
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/PAGE 17
/SYMBOL SORTING ROUTINE
/LENGTH: 63 REGISTERS

SORT,   DCA INFO                /INDICATOR TELLS IF ANY SYMBOLS WERE SORTI
        TAD IAM1                /POINTER TO BEGINNING OF SYMBOL TABLE
        DCA PNT1                /PUT IT IN ADDRESS POINTER
        CMA             /SET HIGH SYMBOL TO 7777 7777 7777
        DCA HIGH
        CMA
        DCA HIGH+1
        CMA
        DCA HIGH+2
LCHK,   TAD PNT1                /HAVE WE CHECKED ALL OF SYMBOL TABLE?
        CLL CMA IAC     /COMPARE POINTER WITH ANOTHER POINTER
        TAD SPNT                /TO THE END OF THE SYMBOL TABLE
        SNA CLA
        JMP AOUT                /ALL THROUGH
        TAD LOWPNT      /SET UP POINTERS FOR CYMBOL COMPARISON
        DCA SORT1       /TO SSEE IF SYM IS GREATER THAN LOW
        TAD PNT1                /GET ADDRESS OF CURRENT SYMBOL
        DCA SORT2
        JMS I SYMCMI    /GO TO SYMBOL COMPARISON ROUTINE
        JMP INC                 /SYM IS EQUAL TO LOW
        JMP INC                 /SYM IS LESS THAN LOW
        TAD HIPNT       /SYM IS GREATER THAN LOW
        DCA SORT2       /NOW SET UP POINTERS FOR CHECK3 ROUTINE
        TAD PNT1                /TO SEE IF SYM IS LESS THAN HIGH
        DCA SORT1
        JMS I SYMCMI    /GO TO SYMBOL COMPARISON ROUTINE
        JMP INC                 /SYM IS EQUAL TO HIGH
        JMP INC                 /SYM IS GREATER THAN HIGH
        ISZ INFO                /SYM IS LESS THAN HIGH
        TAD PNT1                /GET ADDRESS OF SYMBOL
        DCA SORT1       /IN AN INDEX REGISTER
        TAD I SORT1     /PUT THE SYMBOL IN HIGH
        AND MASK                /GET RID OF THE UNDEFINED BIT
        DCA HIGH
        TAD SORT1       /PUT ADDRESS OF SYMBOL IN ADDR FOR DOLL
        DCA TEM3
        TAD I SORT1     /FINISH PUTTING SYMBOL IN HIGH
        DCA HIGH+1
        TAD I SORT1
        DCA HIGH+2
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/PAGE 18
INC,    TAD C4          /INCREMENT POINTER
        TAD PNT1                /FOR NEXT COMPARE
        DCA PNT1                /PUT IT BACK IN PNT1
        JMP LCHK                /GO LOOK AT NEXT SYMBOL
AOUT,   TAD HIGH                /ALL THROUGH, NOW PUT HIGH INTO LOW
        DCA LOW
        TAD HIGH+1      /HIGH+1 GOES INTO LOW+1
        DCA LOW+1
        TAD HIGH+2      /HIGH+2 GOES INTO LOW+2
        DCA LOW+2
        TAD INFO                /WERE ANY SWITCHES MADE IN THIS PASS?
        SNA CLA
        JMP OUT1                /NO: ALL DONE
        JMP ELUP2
HIGH,   0               /STORAGE FOR HIGH SYMBOL
        0
        0
LOW,    0               /STORAGE FOR LOW SYMBOL
        0
        0
PNT1,   0               /STORAGE FOR ADDRESS OF CURRENT SYMBOL
LOWPNT, LOW-1           /POINTER USED WITH AUTO INDEX REGISTER
HIPNT,  HIGH-1          /POINTER USED WITH AUTO INDEX REGISTER


L06,                    /END OF PAGE

        PAUSE
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